

Lifestyle factors: Impact on Obesity Outcomes in Indian Children – A Review

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ABSTRACT

Background: India is undergoing major epidemiological, nutritional, and demographic transitions leading to a change in lifestyle. This tends to increase the incidence of obesity in all age groups. It has become increasingly important to assess lifestyle factors for their associated risk in predisposing overweight and obesity in children and adolescents.

Methods: A literature search of published studies from 2000 onwards was carried out using keywords such as childhood obesity, overweight, India, prevalence, lifestyle factors, dietary factors, physical activity, and family factors, using available scientific public domains such as Google Scholar, PubMed, etc. Studies on children between 5 to 19 years and focussing on prevalence and factors influencing overweight and obesity were included. A data extraction sheet was used to gather and collate information from identified articles.

Results: An increased frequency of outside meals, consumption of fast food, sweets, and soft drinks are significant dietary factors increasing the incidence of obesity in children. Reduced participation in outdoor games and exercise time, television viewing for >2-3 hours/day, vehicular transport to school, reduced sleep duration of <7 hours/day have considerable influence on children's obesity outcomes. Additionally, a family history of obesity and parent's higher educational qualifications are considered to be associated with obesity in children.

Conclusion: With the prevalence of obesity increasing in children as well as adolescents, there is a need to focus on the micro-environments affecting their lifestyle apart from socio-demographic determinants alone. Current studies have demonstrated the contribution of lifestyle factors, family factors, and the role of sedentary activities in understanding the causes and consequences of childhood obesity so that appropriate interventions can be designed.

Keywords: childhood obesity, overweight, India, prevalence, lifestyle factors, dietary factors, physical activity.

INTRODUCTION

Childhood obesity is a major public health crisis today and the prevalence has increased in the last few decades. The primary cause is an imbalance between calorie intake and calories utilized. Factors such as genetic, social, cultural, economic, behavioural as well as environmental, influence obesity in children.

Consequences include health risks of cardiovascular diseases, diabetes, high blood pressure, increased cholesterol levels, and many more, which may precipitate into adulthood. Health problems related to obesity include physical conditions as well as psychological conditions. Environmental factors, lifestyle preferences, and cultural environment play pivotal roles in the rising prevalence of obesity worldwide (Dehghan et al. 2005).

Globally, there has been an increased intake of energy-dense foods that are high in fat; and an increase in physical inactivity due to the increasingly sedentary nature of many forms of work, changing modes of transportation, and increasing urbanization. Changes in dietary and physical activity patterns are often the result of environmental and societal changes associated with the development and lack of supportive policies in sectors such as health, agriculture, transport, urban planning, environment, food processing, distribution, marketing, and education (WHO, 2021). The expanding 'obesogenic' environment increases the propensity of children to consume foods and beverages that are high in calories, energy-dense, or low in nutrients, as well as promoting sedentary lifestyles through reductions in opportunities for active mobility in daily lives (Di Cesare et al. 2019).

Over the past four decades, obesity in children of all ages has increased worldwide, as it has for adults. However, obesity appears to have increased more rapidly in 5–19 year-olds than in younger children, with an eight-fold increase between 1975 and 2016. Recent estimates suggest that 40 million children under the age of 5 years and more than 330 million children and adolescents aged 5–19 years were overweight or obese in 2016 (Di Cesare et al. 2019).

India is a rapidly growing economy, undergoing major epidemiological, nutritional, and demographic transitions. These transitions tend to increase the incidence of obesity in all age groups (Di Cesare et al. 2019). According to the findings in a study, *The Global Burden of Disease*, published in *The New England Journal of Medicine*, India with 14.4 million had one of the highest numbers of children with excess weight (GBD Obesity Collaborators 2015).

In a systematic review of childhood overweight and obesity in Indian children, conducted on published Indian data from 1981 to 2013, an increasing trend for overweight and obesity was observed. The pooled data after 2010 estimated a combined prevalence of 19.3 percent of childhood overweight and obesity, which was significantly higher than the earlier (2001) reported prevalence of 16 percent (Ranjani et al. 2016).

The available literature on childhood obesity in India varies widely owing to its varying geographical, demographic, social, and cultural norms. Earlier studies in India have focused more on socio-demographic factors such as age, gender, and socio-economic status (SES) when analyzing the prevalence of obesity. The trend seems to have changed in the last few years as a consequence of an increase in the prevalence rates of childhood obesity. This has resulted in the evaluation of bio-cultural characteristics in addition to socio-demographic factors.

Contemporary studies on childhood obesity attempt to understand the factors that affect children's environment in terms of their lifestyle and family characteristics. Therefore, it is essential to understand the consequences of lifestyle factors on the prevalence of overweight and obesity in children. Thus, contemporary studies show a changing approach towards

evaluating these factors. The purpose of this review, therefore, is to analyze the impact of these factors on childhood obesity outcomes by reviewing published data and presenting the current scenario from India.

MATERIAL AND METHODS

This review aims to analyze the impact of lifestyle and family factors on childhood obesity outcomes in the context of obesity studies in the current scenario. A review of studies published from 2000 onwards, reporting on prevalence and factors influencing childhood overweight and obesity in India was conducted.

1) Study selection

A literature search of published studies from 2000 onwards was carried out using keywords such as childhood obesity, overweight, India, prevalence, lifestyle factors, dietary factors, physical activity, family factors.

2) Data sources and search strategy

The literature search was done using available scientific public domains such as Google Scholar, PubMed, Cochrane, Elsevier. Cross-references from identified articles were also used to expand the coverage. Websites of official agencies such as IOTF, WHO, were accessed for related information.

3) Inclusion and exclusion criteria

Studies on children between 5 to 19 years and focussing on prevalence and factors influencing overweight and obesity were included, while studies including children less than 5 years, studies measuring obesity in terms of other medical conditions such as cardiac risk and blood pressure, studies focussing on interventions, prevention or treatment of obesity and studies including primarily rural or tribal children were excluded.

4) Data extraction

A data extraction sheet was used to gather and collate information from identified articles. Data was gathered under the following categories: general characteristics of the study (first author's name, publication year, study year, etc.), characteristics of the study population (age, gender of studied participants), study design (Sample size, sampling method, duration of the study, measurements and criteria used, etc), results, conclusions and limitations and need for further research if any.

RESULTS

A total of 32 studies were included based on the inclusion and exclusion criteria. All studies reported on the prevalence of overweight and obesity and associated factors. The range of overweight was 3.1%-24.31% while the range of obesity was 0.73%-16.4%. Such a wide range of prevalence can be attributed to the heterogeneity of assessment criteria such as socio-economic status, age, location, and different growth references used.

These studies have reported on the prevalence as well as associated factors such as lifestyle factors including diet and physical activity-related factors. In addition, some studies have also

highlighted the association of overweight and obesity in children with parental and family factors.

DISCUSSION

It is observed that contemporary research aims to delve into some of the less-explored dimensions of causes as well as consequences within the context of childhood obesity. Some of these include individual and parental factors, environmental factors including home and school environment, effects of the built environment, government and social policies among others. Individual factors including diet-related factors (portion sizes, frequent snacking (excessive caloric intake), time of meals, watching media while eating, etc.) and physical activity-related factors (type and duration of activities), as well as sedentary behaviours such as time and duration of sleep, screen time, etc, are considered to be significant correlates of overweight and obesity in children (Fig.1).

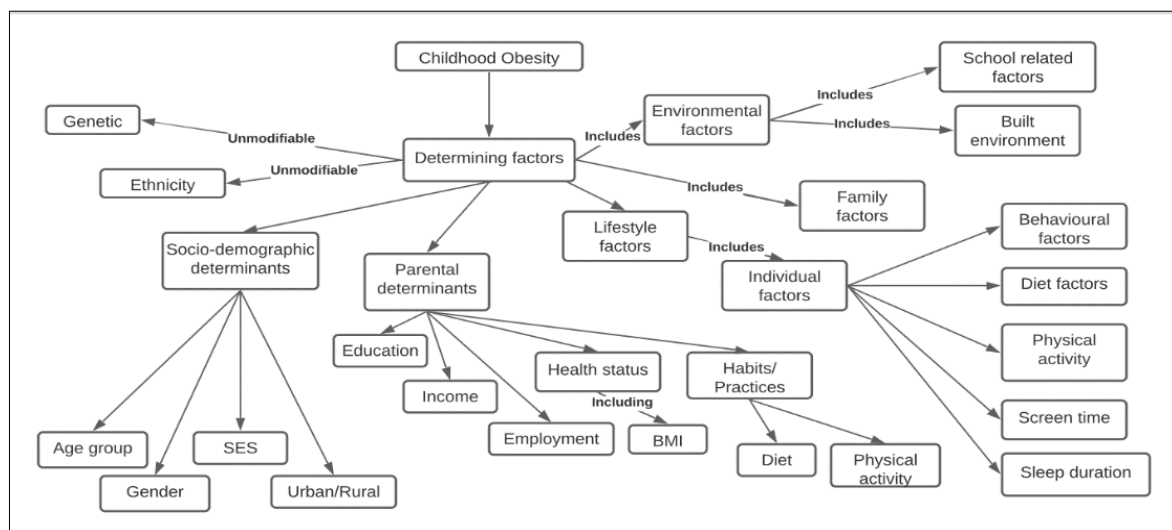


Fig.1 Factors influencing Childhood Overweight and Obesity

Childhood and adolescence are critical periods in the development of diet and physical activity-related behaviours in children. Such behaviours are a consequence of several socio-cultural, family, and lifestyle-related factors. It has become increasingly important to assess these factors for their associated risk in predisposing overweight and obesity in children and adolescents. The observations regarding factors associated with obesity are presented below.

Dietary habits

Diet-related factors are one of the most important factors affecting children's growth status. A few studies have shown a correlation between a mixed diet and the development of obesity. Patnaik et al. (2010), found a higher overweight and obesity prevalence in children with a mixed diet (28.9%). More et al. (2015) also noted that children who consumed a mixed diet had a higher preponderance for overweight (18.9%) than children with a vegetarian diet (13.6%). Similarly, Kulkarni et al. (2016) found that students taking a mixed diet have a significantly higher risk of development of obesity than those who take a vegetarian diet ($p < 0.05$; $OR = 1.693$).

Furthermore, the frequency of consumption of outside meals has been shown to increase the incidence of overweight/obesity in children. Kumar and Faisal (2015), in their study, analyzed data from 1721 students in Vijaywada and found that eating outside the home (main servings/week >2 ($P=0.00$; $OR=9.134$) was observed in 4.21% obese/overweight children. Moreover, eating while watching TV was observed ($P=0.03$; $OR=3.976$) in 14.20% obese/overweight children and frequency of snacking outside ($P=0.021$; $OR=2.891$) seen in 5.49% obese/overweight children, which was associated with a greater risk of developing overweight and obesity.

De Souza (2009), in a study on two groups of boys, one obese and one with normal weight, found that significantly greater eating out episodes were seen in the obese children and they also consumed a significantly greater number of soft drinks per week compared to the non-obese children ($p=0.0001$). Similarly, Lokhande et al. (2017) (2-4 times/week frequency in 41.9% children) and Patil and Rana (2018) (3-4 times/week frequency in 22% overweight children) reported that the overall prevalence of overweight and obesity was more in children eating outside home more than 2 times per week. Kumar and Faisal (2015), also found eating outside home- main servings/week >2 ($P=0.00$) and frequency of snacking outside ($P=0.021$) to be major risk factors. In addition, they found that with daily snacking outside, the risk of developing overweight and obesity was found to be 2.891 times. Furthermore, Patil and Rana (2018), found that compared to 15% of the normal-weight children, 32% of the overweight children ate outside >4 times per week ($p<0.05$). A recent study by Gayathri D et al. (2020) in a group of children from Pondicherry found that 70% of the students dine outside once or twice a week compared to 19.3% who do not dine outside.

Consumption of junk food is another factor considered to be significantly associated with obesity prevalence in children. Jain S et al. (2010) showed that consumption of high energy fried food and junk food show a significant association ($p<0.05$) with the prevalence of adolescent obesity (10.01%). Similarly, Patnaik et al. (2010), reported a high prevalence of overweight and obesity in children consuming junk food regularly (42.86%). Chakraborty et al. (2011), in their study on school children from Kolkata, studied the risk factors in terms of dietary habits, and their outcomes with their BMI attributes. The average fast-food intake in terms of the number of times per week among the obese children was 5.43 ± 0.34 and in overweight was 4.11 ± 0.56 , compared to children with normal BMI it was 2.29 ± 0.69 . In a recent study, Dutt et al. (2020) also found the association between fast-food eating and obesity to be significant ($p<0.05$).

In a cross-sectional study carried out in affluent public schools of Bangalore, Garg et al. (2014) found that junk food and chocolate eating habits were more prevalent in overweight and obese than underweight children, showing an association of caloric intake with increased BMI. Katkuri et al. (2015), also noted that among diet-related factors those significantly associated in children from both private and government schools were intake of soft drinks (2-3 times/week frequency in 31.1% children) and daily sweets (2-3 times/week frequency in 16% children), while children belonging to private schools also showed an increased intake of pizza and fruits (daily consumption in 18.1% children). While John M et al. (2016), also found that

the frequency of intake of fried food significantly influenced BMI with daily consumption of fried foods in 47.17% of obese children. In addition, Sarvamangala and Koujalgi (2017) reported that consumption of snacks was more than 3 times a week for 26.4% of obese children compared to only 2.6% in non-obese children ($p < 0.001$). Rathod and Hadaye (2019), in their study, observed that 12.02% of normal weight students compared to 44.44% overweight/obese students had fast food 4 times/week and the difference was statistically significant. In a recent study, Viswambharan et al. (2020), found that children showing frequent and excessive sweet consumption had 3 times more chance of being obese.

Together these studies indicate that dietary factors such as type of diet, consumption of junk food, and frequency of eating meals outside the home have a significant association with growth outcomes in children, especially in terms of their BMI.

Physical activity

Overweight as well as obesity is positively correlated with less exercise and reduced physical activity. Prevalence of obesity was shown to be more in children who spent less time in physical activities. This was reported by Monga (2004), S Kumar et al. (2007), Bharati et al. (2008), Kotian et al. (2010), Jain S et al. (2010), Patnaik et al. (2010), Vohra et al. (2011), Kumar and Faisal (2015), Kar and Khandelwal (2015), John M et al. (2016), Hussain M et al. (2016), Kulkarni et al. (2016), and Patil and Rana (2018), to be statistically significant. Together these studies highlight the correlation of obesity with reduced exercise and physical activity.

In a study by Laxmaiah et al. (2007), it was found that the prevalence of overweight and obesity was significantly lower (3.1%) among the adolescents who participated in outdoor games ($p < 0.004$) than among the non-participants (9.7%). Similarly, Patnaik et al. (2010), found a higher prevalence of overweight and obesity in children not playing outdoor games (40.8%) and not doing regular exercise (33.9%). In their study, John M et al. (2016) found a significant influence of physical activity on BMI denoted by hours of play. The authors found more than 60% of the children in the obese and overweight group having play hours less than 1 hour ($p = 0.05$).

Correspondingly, Sarvamangala and Koujalgi (2017) reported that 96.5% of non-obese children compared to only 3.5% of overweight/obese children were involved in more physical activities. They also found that 94.5% of children who were involved in household activities were non-obese compared to 5.5% of obese children. Similarly, Jain S et al. (2010), showed that reduced physical and sports activity (10.30% obese children) was found to be significantly associated ($p < 0.05$) with obesity in adolescents. While Patil and Rana (2018), found 55% of the overweight children were physically active for less than 30 minutes per day ($p < 0.05$). In addition, Kumar and Faisal (2015), found that decreased frequency of playing outdoor games was a significant risk factor ($p = 0.00$). Not playing outdoor games at all was associated with 1.799 times greater risk of developing overweight and obesity.

Chakraborty et al. (2011) showed the average outdoor activity was also less among obese (4.12 ± 0.92) and overweight (5.88 ± 0.59) children compared to normal BMI children (8.17 ± 1.11). In their comparative study of government and private schools in Hyderabad, Katkuri et al. (2015) noted that a less frequency of outdoor sports was a significant risk factor among students of both private as well as government schools. In a recent study, Dwivedi and Sengupta (2019)

observed that subjects spent more time performing sedentary activities and only a minimum (27.6%) percent met the daily requirement of performing moderate to high-intensity activity i.e., on an average of ≥ 60 min/week.

Collectively, these studies highlight the critical role played by factors related to the physical activity of children. This indicates a need to examine and understand the reasons why physical activity in children has reduced in terms of having fewer play hours, reduced exercise time, and lower participation in outdoor games and sports.

Physical inactivity/sedentary activity

More recent attention has been focused on factors such as increased screen time, mode of transport to school, sleep duration, etc. Prolonged screen time appears to be a contributing factor in childhood obesity since it represents a sedentary lifestyle, replacing time spent in physical activities. Important factors linked to obesity prevalence are increased screen time (>2 hours/day), mode of transport to school, and duration of sleep (<8 hours/day) among others. Several studies have revealed that the prevalence of overweight and obesity among children and adolescents watching prolonged hours of the screen (television, computer, etc.) was significantly higher compared to children watching fewer media.

For instance, in a study by De Souza (2009), comprising of two groups, a study group of obese boys was compared with a control group of boys having normal weight. The author noted that obese children had significantly greater television viewing time compared to non-obese children ($p=0.0001$). Consequently, the obese group also showed a lesser number of hours of physical activity and play in a day ($p=0.0001$). Similarly, Sarvamangala and Koujalgi (2017), reported that 13.7% of TV viewing children were obese and this association was significant ($p<0.001$). Similarly, Jain S et al. (2010), showed that prolonged TV watching for more than 2 hours was found to be significantly associated ($p<0.05$) with obesity in adolescents (7.38% obese children). More et al. (2015) also observed that children with a history of watching television >1 hour/day showed a higher prevalence of overweight (16.2%) when compared to children watching television for <1 hour/day (13.3%). In the same manner, Kulkarni et al. (2016) found that the duration of TV/computer watching (≥ 2 hours/day) was significantly higher in overweight/obese children ($p<0.05$; OR=2.098). However, Kumar and Faisal (2015), found watching TV/using a computer for more than 3 hours per day ($p=0.02$) was associated with a slightly increased risk. Gayathri D et al. (2020), in their study, found that more than 70% of the study population spent 1 to 2 hours on television and mobile phones.

Recent evidence suggests that the mode of transport to school also appears to be an important factor influencing obesity prevalence. For instance, Gamit et al. (2014) reported higher rates of obesity (7.2%) and overweight (12.5%) in children going to school in a vehicle compared to those who went on foot (obese, 5.4%; overweight, 8.8%) or cycled (obese, 2.4%; overweight, 5.5%). They emphasized that the association between the mode of conveyance to school and BMI was statistically significant ($p=0.00$). Similarly, John M et al. (2016) noted that for nearly 95% of the obese children the mode of transport to school was a vehicle, which was statistically significant ($p<0.05$). Patil and Rana (2018), showed that compared to 45% of the normal-

weight children who traveled in a vehicle, 68% of the overweight children traveled in a vehicle ($p < 0.05$). In addition, Kumar and Faisal (2015), found that children who went to school in an automobile were at 1.76 times higher risk compared to children who walked to school.

Recently, researchers have also shown an interest in analyzing the association of duration of sleep with obesity outcomes. Some researchers have found an association of children's reduced sleep duration (< 7 hours/day) towards overweight when compared to children whose sleep duration was 9 hours and above per day. De Souza (2009) in his study showed that obese children slept for a lesser number of hours per day than non-obese children in the study population ($p = 0.0001$). In their study, Anuradha et al. (2015) reported more overweight (21.8%) and obesity (10.9%) in children with sleep duration of 7 hours and below when compared to children with 9 hours and above (overweight, 8.9%; obesity, 4%). Similarly, Kulkarni et al. (2016) found more prevalence of overweight/obesity (27.78%) in children with < 8 hr sleep duration compared to ≥ 8 hr duration (9.85%). They noted that the risk of obesity was significantly more in children who slept for < 8 hours than children who slept for ≥ 8 hours ($p < 0.05$; OR=2.588). They also reasoned that a greater sleep duration leads to a higher likelihood that children will be more physically active leading to a lower risk of being overweight. In the same manner, Hussain M et al. (2016) showed the prevalence of overweight/obesity to be more in those children who slept for < 6 hours/day (8.75%).

The evidence reviewed here seems to suggest a pertinent role for factors representing sedentary behaviour. These factors are related to the lifestyle of children and imply the importance of such factors in the propensity of an individual to overweight and obesity.

Parental/family factors

Parental factors include parents' employment, food preferences, parental feeding style, involvement in food preparation, etc. Family factors such as type of diet, family history of lifestyle diseases, etc, are also considered to be associated with obesity.

An important factor influencing overweight and obesity outcomes in children and adolescents is a family history of obesity and other conditions such as hypertension and diabetes mellitus. It has been reported that children with a family history of obesity showed a significantly higher prevalence of overweight and obesity. For instance, Patnaik et al. (2010) found a higher prevalence in children with a family history of obesity (39.79%). More et al. (2015) noted that the prevalence of overweight (13.6%) and obesity (13.6%) was more among those with a history of obesity in the family. Similarly, Sarvamangala and Koujalgi (2017), noted that in 18.4% of obese children, there was a parental history of obesity which was statistically significant ($p < 0.001$).

In addition, Vedavathy S et al. (2016) found a statistically significant correlation between family history of obesity (in 9.9% children), hypertension (in 19.4% children), diabetes mellitus (in 8.7% children), cardiovascular diseases (in 1.2% children) and incidence of obesity in adolescents. The analysis by Patil and Rana (2018) revealed that having at least one overweight parent was associated with obesity. In a recent cross-sectional study by Pedapudi et al. (2020) in Bengaluru, it was observed that students who reported a history of obesity in their family were more likely to be overweight or obese than students who did not indicate the presence of family obesity (OR=2.44; 95%CI=1.72-3.33; $p \leq 0.001$). They also noted that

overweight/obesity prevalence was higher in students who reported a family history of diabetes (28.7%), or hypertension (28.7%) compared to those who did not (25.5% & 26.2% respectively), but this was statistically not significant. Similarly, Dutt et al. (2020) also found that 15% of obese children from the study population had a family history of overweight/obesity compared to that of non-obese children (7.5%) which was statistically significant ($p=0.0425$, $p<0.05$).

The prevalence of obesity has also been linked to factors such as parents' education and employment. In their study, Gamit et al. (2015) found a significant association between father's and mother's occupations and overweight and obesity. The rate of overweight (15.6%) and obesity (16.7%) was higher in students whose fathers had a higher level of education. Similarly, a higher prevalence of overweight (19.4%) and obesity (14.9%) was found in the students whose mothers had a higher level of education, and the results were statistically significant ($p=0.001$). There was a significant association between father's and mother's occupation and overweight and obesity ($p = 0.001$). Likewise, Anuradha et al. (2015) reported that overweight and obesity prevalence was 17.7% & 7.3% respectively in children with father's higher qualification and 19.5% & 8.7% in a family with higher income, emphasizing that children belonging to educated parents and parents with a high-income show higher rates of overweight and obesity. Viswambharan et al. (2020), in their cross-sectional study among adolescent school children from North Kerala, found that the better the father's education the higher the chance of overweight/obesity ($p=0.006$).

Correspondingly, Kulkarni et al. (2016), found that children (27.86%) of employed mothers had a higher risk of developing overweight and obesity than children (19.00%) of non-employed mothers. Similarly, Kumar and Faisal (2015) reported that when both parents of the child were working ($p=0.02$; $OR=2.695$), the child was found to be 2.695 times at risk of developing overweight and obesity.

These studies indicate that parental and family factors are significantly associated with an increased risk of developing overweight and obesity. Other factors such as school-related factors (school timings, access to playground, duration of physical education in school, etc.) require a more detailed investigation.

Conclusion

The above studies have demonstrated the contribution of lifestyle factors (diet and physical activity), parental, family factors, and sedentary behaviours such as watching increased screen/media, mode of transport, and reduced sleep duration in understanding the causes and consequences of obesity outcomes in children.

In all the studies reviewed, lifestyle factors have been recognized as one of the most critical components of obesity studies. Contemporary research shows that children's lifestyles are characterized by the habits and behaviour that they cultivate owing to parental, familial, and environmental factors. Since these factors are modifiable, it is crucial that these have to be dealt with in-depth. With prevalence increasing in children as well as adolescents, there is a need to focus on the micro-environments affecting their lifestyle apart from socio-demographic

determinants alone. The main aim of such research studies is to understand the causes of childhood obesity so that appropriate interventions can be designed. Therefore, lifestyle factors and family characteristics are now a focus of obesity studies.

Factors involving school environments such as choice of snacks in the school canteen, the distance of the school from residence, and additional factors such as reduced opportunities for physical activities, appropriate recreational facilities, the aesthetic quality of neighbourhoods, assessment of media impact, advertisement effects, etc. are some of the new areas for research development.

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